Swami Ramanand Teerth Marathwada University,
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(UGC recognised, NAAC Re-accredited 'B++' grade state university)

"STUDIES ON EFFECT OF HEAVY METALS ON THE SCALE, CHROMATOPHORE AND BIOCHEMICAL PROFILE OF FRESHWATER FISH *CHANNA STRIATUS"*

Research Proposal Submitted

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INTRODUCTION:

God has created this beautiful world with lots of colors. Among all vertebrates various color pattern present in fishes. Colouration in fishes is due to the presence of various kinds of pigments in the integument. Color in fishes is due to the presence of chromatophores and iridocytes. Various kinds of pigments such as carotenoids[yellow, red], melanin[black], purines[white or silvery], erythrophores[red/orange]. The yellow, red, orange pigments are taken through food, while the black pigments are the result of breakdown of amino acids[tyrosine].

Fish have been used for many years to determine the pollution status of fresh water and are regarded as excellent biomarker in aquatic ecosystems. Heavy metals occur in environment both as a result of natural process and pollutants by anthropogenic activities. Various kinds of heavy metals like Cd,Ar,Hg,Pb,etc. present in water. Chaplen et. al.[2002] studied the ability of scale chromatophores to inform the potential presence of environmental toxins such as heavy metals, pesticides and pathogenic bacteria.

Allen et.al.[2004] reported that arsenic concentrations affected the structure and number of chromatophores and proposed the use of fish chromatophores as a reliable biomarker of aquatic arsenic pollution. Ahmed S. et.al.[2018] studied effect of cadmium chloride on general body coloration and chromatophores in fish. Seasonal variation in chromatophores/color occurs in fishes Krishan et.al.[2016] shows significant seasonal difference in chromatophore indices for all the size groups.

Animal species, ranging from insects to different vertebrates, have characteristic body colors and patterns often evolve as adaptation to environmental surroundings, in which it frequently resulted in cryptic coloration [Rekha et al.][2016].

Channa striatus is a species of snakehead fish. It is commonly known as snakehead murrel, appears cylindrical with elongated body; head flattened and snake-like. The male fish shows slender body than female ones. It has single dorsal fin with 37-46 rays that covers most of the entire length of the body. Its anal fin with 23-29 rays appears more than half the length of the dorsal fin. Rounded caudal fin of diphycercal type and thoracic type of pectoral fin rays can be observed spinous soft type. The large superior mouth consists of 4-7 canine teeth behind a single row of villiform teeth. Upper jaw teeth shape is primarily multicuspid. Protruding lower jaw is evident in this species.

The term water pollution is referred to any type of aquatic contamination. The major effluent causing pollution in riverine and estuarine system of India are the industrial wastes from the factories like textiles, distilleries, petrochemicals oil refineries, fertilizer, etc. A toxic heavy metal is any relatively dense metal or metalloid that is noted for their potential toxicity especially in environmental context. For examples lead, cadmium, arsenic, chromium, zinc, etc.

Some metals are essential for normal physiological functioning of fish but become toxic when they accumulate in their body tissue. [Bharti Dwivedi et al 2015]. Arsenic contamination has been ubiquitously reported worldwide. Level of arsenic is relatively higher in the aquatic environment than in land because of its solubility in water. Fishes are relatively sensitive to even minor changes in their surrounding environment and thus can be used as a successful experimental model for assessing potential risk associated with contaminated aquatic ecosystem [Sharddha et al 2015].

Mercury has many industrial uses, such as in the manufacture of plastics, chlorine, caustic soda and caustic potash and agricultural fungicides. These industries are responsible for the discharge of mercury and its compounds into the aquatic environment. Inorganic mercury is the most common form of the metal released in the environment by industries, presenting a stronger acute effect on aquatic organism than that of the organic form of mercury. Toxicological studies of the pollutants upon aquatic organisms are very important from the point of environmental consequences. Fishes are often forced to encounter in the highly contaminated water especially in areas where the dilution rate of waste water is low. Fish species can be used as test organism because, it is the best understood aquatic species and can be a frontline indicator of suspended aquatic pollutants such as metals.

Fish scales are a remarkable adaptation that serve various functions, including protection, movement, and environmental adaptation. There are various types of fish scales, each with unique characteristics like placoid scales, ganoid scales, cycloid, ctenoid, cosmoid scales. Fish scales have evolved to fulfill various functions. Apart from protection and aiding movement, scales can also contribute to thermoregulation, camouflage and even sensory functions. Additionally, the arrangement of scales can provide insights into a fish growth pattern and age. Fishes are relatively sensitive to changes in their surrounding environment. Fish health may thus reflect and give a good indication of the health status of a specific aquatic ecosystem. Metallic compounds present in effluents may accumulate in various organs of

animals or cause huge modification in plant and fish biomass production. Proteins are playing important role in major physiological events therefore the evaluation of the protein content can be treated as a diagnostic tool to define the physiological phases of any organism. Proteins are highly sensitive to heavy metal toxicity.

Present study deals with the investigations on changes in Scale, chromatophore and biochemical profile due to the effect of heavy metals in fish *channa striatus*. *Channa striatus* is commonly available in fish markets of Nanded city, Maharashtra state, India.

Purpose Of Carrying Out Proposed Research Work:

An important step in successful completion of an research work is starting off with an accurate and precise purpose statement:

Studying chromatophores in fishes is most simple and easiest, non-expensive way to determine the changes in habitat and fish body because that get reflected fully or to some extent on fish chromatophores. Color in fishes is used for concealment, communication, camouflage, sexual recognition and advertisement, warning or threat. Coloration also has taxonomic value. Different color pattern in fish is often considered as character for distinction among species and subspecies. Chromatophores are important that contribute characteristic quality criteria for the marketing and consumer demands of aquacultural products. Fish chromatophores can be successfully employed as indicator of waste water pollution or metal contamination. Studying biochemical estimations in fish is to gain valuable insights into their health, physiological status and overall well-being.

REWIEW OF LITERATURE:

The review of literature given as under indicates that the study which is planned through the selected method and fish is not worked out in Nanded district. The data on the selected topic is very fragmented and huge scope to workout.

D Burton [2011] studied coloration and chromatophores in fishes and provide useful information about physiological and morphological color changes, the regulation of color changes, how do fish change color? etc.

Sugimoto [2002] studied morphological color changes in fish, long term adaptation of fish to a certain background, how chromatophores change their density, increase and decrease in

chromatophores number. Roohi gulzar, Aadil Yaqoob and Ajai Kjain [2014] studied by subjecting the fish to two different background, white and black.

Shraddha Dwivedi [2015] studied arsenite toxicity in terms of behavioural, morphological and chromatophoric alternation. It studied scales shows and aggregation of pigment granules in arsenite exposed groups in a concentration dependent manner. Tanu Allen [2003], examined the possibility of using fish chromatophores as markers of arsenic exposure. It also compare results between arsenic accumulation melanophore index and neurosecretory cells. Ahamd Shareef [2018] investigator revealed that the structure and number of chromatophores alternation. Degenerative changes, peeling and fading of skin, acute and sub-acute change in chromatophore number along with necrotic, lytic and degenerative changes. It also investigated gradual change in chromatophore from reticulate to punctuate- stellate and aggregation of melanin towards centre.

Krishan Rajkant [2016] deals with the seasonal changes in color/ chromatophores in *puntius sophore*. This indicates that chromatophores are concentrated in the monsoon and in post monsoon the chromatophore index decrease. It shows that during monsoon period when there is plenty of floods and water becomes muddy in streams and rivers, the chromatophore begin to concentrate in the scales of the fish and density of chromatophores increases and develop dark black color so as to become visible.Sohini Singh [2014] investigated sublethal effects of arsenic trioxide, cadmium chloride, lead nitrate and mercury chloride, were investigated on chromatophore morphology and behaviour of *channa punctatus*. Changes were observed in the chromatophore pattern of fish scales and in the fish behaviour after administrations of the heavy metals. M.Javed [2014] studied the haematological parameters and glycogen serve as suitable biomarker of fish health and can be used as the indicators to monitor the quality of aquatic environment. Sweety R. Remyla [2007] the haematological and biochemical profiles of a fresh water fish *Catla catla* were studied under sublethal toxicity of cadmium chloride.

IMPORTANCE OF THE STUDY:

Studying chromatophores in fish is important for several reasons, as these specialized cells play crucial role in the physiological, ecological and behavioural aspects of fish species. Many fish species use chromatophores to change their color and patterns to blend into their surroundings, effectively camouflaging themselves. The color changes in chromatophores are also frequently involved in mating rituals and courtship displays. By studying these changes

researchers can gain insights into the reproductive of fish species. Changes in chromatophore activity and color patterns can also serve as indicators of the health and stress level of fish. Abnormal coloration might be an early sign of disease or environmental stressors. Understanding how environmental factors influence color changes and patterns can help improve the well-being and productivity of fish farmed fish populations. Studying chromatophores in fish provides insights into a variety of topics, from animal behaviour and communication to ecology and environmental adaptation.

INTERNATIONAL STATUS:

On the fish chromatophores abundant research work done in various countries viz. India Japan, USA, Canada and Australia,etc. The work like morphological color change in fish was done in Japan. Nuptial coloration in fish work done in Sweden. Work like adaptive significance of chromatophores. Scales are used as biomarkers of pollutant and water quality. On biochemical composition work done in Bangladesh, Malaysia, China, etc. Work like effect of toxic metals in popular farmed fish species and estimation of health risks through their consumption, bioaccumulation of heavy metals in fishes.

NATIONAL STATUS:

On the fish chromatophores research work done in various states in India like Punjab, Madhya Pradesh, utter Pradesh, etc. The work like behavioural, morphological, and chromatophoric alternations and effect on general body coloration and chromatophores,etc done on coloration / chromatophores on fishes.Research work related to biochemical estimation done in Maharashtra, Madhya Pradesh etc. Study like impact of industrial effluents on the biochemical composition, effect of heavy metal toxicity on the biochemical parameters.

SCOPE OF STUDY:

1] Fish scales and chromatophores can be successfully employed as indicator of waste water pollution or metal contamination.

2] Chromatophores pigmented cells which plays vital role in survival of species like by camouflage, abilites to change color may aid in the need to become obscure or to advertise socially.

3] Chromatophores are important that contribute characteristic quality criteria for the marketing and consumer demands of aquacultural products.

4] Chromatophores play a crucial role in the coloration and patterning of fish, which serves a multitude of purposes including concealment, sexual recognition and even providing insights into the morphological structure of these cells.

5] Biochemical analysis can help to determine the accumulation of heavy metals, pollutants and toxins in fish tissues. This study helpful for assessing the health risks associated with fish consumption and the overall aquatic ecosystem health.

OBJECTIVES OF THE RESEARCH:

1] To determine the detail morphology of chromatophore and scale of selected fish using microscopy.

2] To study the effect of background on the coloration in fish.

3] To study the effect of Arsenic trioxide on chromatophore in fish.

4] To study the effect of Mercurychloride on chromatophore in fish.

5] To study the effect of Arsenic trioxide and Mercury chloride on scales of fish.

6] To study the effect of Arsenic trioxide and Mercury chloride on biochemical profile in tissues of selected fish.

HYPOTHESIS:

Chromatophores are pigment containing cells found in the skin of fish. Metal exposure will lead to noticeable alternations in the chromatophores of the skin. This could manifest as changes in color, pattern, size or even the overall distribution of chromatophore on the skin. Metal compound can adversely affect cellular health. Alternations in color patterns due to metal exposure could influence their behaviour. For Instance, they might struggle with camouflage, which could affect their survival in natural environments. Background adaption in fish refers to their ability to change their coloration to match the colors and patterns of their environment. This hypothesis posits that fish exposed to various background environments will undergo color changes as a means of adapting to their surroundings. Metal contaminants, such as heavy metal, can have harmful effect on aquatic ecosystem due to their toxic nature. Exposure to metal contaminants might lead to alternations in the morphology of

fish scales. This could include changes in scale size, shape and arrangement. The presence of specific pollutants in aquatic environments correlates with the accumulation of corresponding biomarkers in tissues.

METHODOLOGY TO BE USED AND ADOPTED:

The study is not area specific rather than it is fish specific. Fish samples will be collected from Godavari Riverand its tributaries, all major and minor reservoirs from Nanded [Maharashtra]. The scale and chromatophore will be studied by microscopic method. Biochemical profile of tissues will be carried out by standard method.

LIMITATIONS OF THE WORK:

The development of a portable device capable of taking an environmental sample, detecting its effects on chromatophores in a timely fashion requires an enormous effort utilizing the skills of both biologists and engineers. Background adaptation in fish is commonly studied by using Munsell Grey Series Index Number [M.C.I] no other better scientific method is invented yet.

EXPECTED OUTCOME:

This study is helpful for the ability of chromatophores to rapidly change color and patterns.Research on fish chromatophores can generate new knowledge about color in fishes related to concealment, communication, camouflage, sexual recognition, and morphological structure of chromatophore of fish *channa striatus*. Chromatophores have color changing capabilities, marketers could use this as a unique selling proposition. Changes in fish coloration and chromatophores behaviour can serve as indicators of environmental stressors, pollution and shifts in ecological conditions. Monitoring chromatophore response could potentially provide an early warning system for environmental changes and pollution impacts on aquatic ecosystems. Research on chromatophores helps to reveal how different fish species have adopted to their specific habitats and lifestyles. This study overall will be helpful for the study of coloration in fishes. Biochemical estimation in fish helpful for scientific knowledge, conservation, sustainable resource management and a holistic understanding of aquatic ecosystems. These outcomes have practical applications that benefit both the environment and human societies.

YEAR WISE PLAN OF WORK AND TARGETS TO BE ACHIVED:

As given below the thesis is divided into various chapters year wise, accordingly the investigation of the problem will be carried out.

Year -1: Morphological study of chromatophores and scale in selected fish. Effect of background on the coloration in fish.

Year -2: Study the effect of Arsenic trioxide and Mercury chloride on scale of fish. Study the effect of Arsenic trioxide and Mercury chloride on chromatophore of fish.

Year -3: Study the effect of Arsenic trioxide and Mercury chloride on biochemical profile in selected fish. Final synopsis and thesis writing.

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Research Guide

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